29 October 2004

To: Paul Philp
DOE Project Manager, Run IIb CDF Detector Project

From: Pat Lukens
Project Manager for the Run IIb CDF Detector Project

Subject: Run IIb CDF Detector Project September 2004 Report

Attached is the monthly report summarizing the September 2004 activities and progress for the Fermilab RunIIb CDF Detector Project. This report is available electronically at:

http://www-cdf.fnal.gov/run2b.html

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RunIIb CDF Detector Project
Progress Report No. 22
1 - 30 September 2004

I. PROJECT DESCRIPTION

The primary goal of the CDF Run IIb Detector Project is to enable the detector to exploit the physics opportunities available during Tevatron operation through 2008. The data from Run II will represent a set of detailed measurements that can be compared with the predictions of the Standard Model at the highest available collision energy. The increased size of the data sample will allow us to study the top quark by measuring the details of its production and decay mechanism. In addition, we plan precision electroweak and QCD measurements, continued searches for a variety of phenomena that are predicted to exist beyond the Standard Model framework, and to explore CP violation in the *b* quark sector. The detailed physics goals of the upgrade are described in the Technical Design Report (TDR).

The major tasks of this upgrade are:

- Upgrade the calorimeter by replacing the Central Preradiator Chamber with a device with shorter response time to allow operation in a high-luminosity environment, and adding timing information to the electromagnetic calorimeters.
- Upgrade the data acquisition and trigger systems to increase throughput needed for higher luminosity operation and efficiently trigger on the higher multiplicity events of Run IIb.

II. OVERVIEW OF PROJECT STATUS – P. Lukens

Although not strictly within the scope of the project, the installation of a major project component, the calorimeter preshower upgrade, is now in progress. This installation will continue until the end of the current accelerator shutdown. Good progress has been made so far. Three arches (of 4) now have new detector modules installed, and the procedure for installation appears to work well. We do not anticipate that this installation will impact accelerator operations. Installation of the electromagnetic timing components is essentially complete. Both of these systems will be used in the data taken when operations resumes in November.

An internal review of the TDC project and the capabilities of the current TDC's was held on 28 September. The charge to the review committee was to recommend whether production of the new TDCs should proceed. Significant improvements in the capability of the old TDCs has been made since the time of the project baseline. The review committee concluded that the current TDCs would meet the performance specification for the project, and can be used without jeopardizing the mission of the project. They recommended that the old TDCs be used for the remainder of the operation of the experiment. This course of action was felt to present the lowest overall risk. Consequently, the scope of the project will be adjusted to reflect this new strategy.

The silicon detector subproject was closed out at the end of September, 2004. All cost codes associated with that effort were closed, so that no additional costs can be incurred. A few purchase orders remain open, for vendors that have not yet invoiced Fermilab for their services.

III. PROJECT MILESTONE SUMMARY (as of 30 September 2004)

CDF Data Acquisition Level 1 and Level 2 Milestones
Sorted by Baseline Completion Date

WBS	Title	Baseline Comp. Date	Forecast/Actual Completion Date	Complete
1.3.2.6.3	Begin production of Level 2 Pulsar system	12 Nov 03	12 Nov 03	Yes
1.3.1.6.6	First Prototype TDC available for testing	19-Nov-03	16-Feb-04	Yes
1.3.4.4.1.4	Prototype Event Builder hardware arrives	3-Jun-04	31 Mar 04	Yes
1.3.2.10	Pulsar Hardware Ready for Installation	31-Aug-04	31-Aug-04	Yes
1.3.6.1.1.7	Begin AMS Design Work	1-Sept-04	2-Aug-04	Yes
1.3.6.1.3.7	Begin Track Fitter Design	1-Sept-04	2-Aug-04	Yes
1.3.4.5.3	Production Readiness Review - Event Builder	4-Oct-04	2-Jun-04	Yes
1.3.4.5.4.4	Arrival of the Event Builder hardware	15-Oct-04	15-Oct-04	
1.3.11.8.5.5	Begin Purchase of Pulsar Board components	20-Oct-04	20-Oct-04	
1.3.11.5.3.8	Begin Production TDC Mezzanine Card	28-Oct-04	5-Nov-04	
1.3.6.2.6.4	Begin Ampchip Production	10-Jan-05	3-Dec-04	
1.3.1.12	Beginning of TDC Production	11-Jan-05	14-Feb-05	
1.3.6.2.1.1.5	Begin AMS Mezzanine Card Production	14-Jan-05	28-Oct-04	
1.3.11.6.3.6	All TDC to Finder cables Received	18-Mar-05	28-Feb-05	
1.3.5.3.7	Arrival of 15 PCs from the vendor	23-Mar-05	23-Mar-05	
1.3.2.9	Pulsar Level 2 subproject ready for installation	1-Apr-05	1-Apr-05	
1.3.11.8.8	Begin Joint Testing with Finder Board	4-Apr-05	1-Apr-05	
1.3.11.7.5.8	Begin Production of SLAM Boards	18-Apr-05	8-Apr-05	
1.3.11.4.4.8	Begin Production TDC Fiber Transition Boards	21-Apr-05	13-Apr-05	
1.3.1.17.4	TDC Readout System Complete	6-Jun-05	6-Jun-05	
1.3.11.5.3.9	Checkout of TDC Mezzanine Cards Complete	6-Jun-05	20-Jun-05	
1.3.11.2.5.1	Begin Production XFT Finder Boards	8-Jun-05	31-May-05	
1.3.6.1.2.5	Hit Buffer Firmware Complete	23-Jun-05	23-Mar-05	
1.3.6.1.3.5	Track Fitter Firmware Complete	28-Jun-05	31-Mar-05	
1.3.1.13.7.10	TDC's (to populate entire COT) ready to install	27-Jul-05	20-Sept-05	
1.3.4.8	Finish Event-Builder Upgrade	28-July-05	28-July-05	
1.3.5.5.5	Arrival of 70 Level3 and 15 DAQ PCs	15-Aug-05	15-Aug-05	
1.3.5.6.5	Arrival of 140/20 PCs from the vendor	15-Aug-05	15-Aug-05	
1.3.6.1.1.5	AMS Firmware Complete	19-Aug-05	28-Feb-05	
1.3.6.3	SVT ready for installation	25-Aug-05	26-July-05	
1.3.5.8	Finish Purchase of Computers for L3 DAQ system	6-Sept-05	6-Sept-05	
1.3.11.4.4.9	Checkout of TDC Transition Boards Complete	16-Sept-05	8-Sept-05	
1.3.11.7.5.9	Checkout of SLAM Boards Complete	28-Sept-05	28-Sept-05	
1.3.11.2.5.10	Finder Board Checkout Complete	29-Sept-05	21-Sept-05	
1.3.11.10	XFT Ready for Installation at CDF	29-Sep-05	29-Sep-05	
1.3.1.13.10	TDC Production Board testing complete	30-Sep-05	30-Sep-05	
1.3.1.16	Run 2b TDC Ready for Installation	30-Sep-05	30-Sep-05	
1.3.8	Finish Run 2b Trigger DAQ project	30-Sep-05	30-Sep-05	
1.3.9	DAQ and Trigger Upgrades Ready for Installation	17-Jan-06	30-Sep-05	

CDF Calorimeter Level 1 and Level 2 Milestones
Sorted by Baseline Completion Date

WBS	Milestone	Baseline Completion Date	Forecast/Actual Completion Date	Complete
1.2.1.10.1	First phototube order placed	9-May-03	1-Apr-03	Yes
1.2.2.2.7.1	Prototype testing complete	16-May-03	28-Mar-03	Yes
1.2.2.2.7.4	ASD->TDC Cables ready for installation	16-May-03	26-Aug-03	Yes
1.2.2.2.7.2	CEM Splitters ready for installation	19-May-03	29-Jul-03	Yes
1.2.2.2.7.3	PEM Harnesses ready for installation	2-Sep-03	28-Apr-03	Yes
1.2.2.2.7.5	All EMT cables done and ready to install	2-Sep-03	26-Aug-03	Yes
1.2.2.2.7.8	VME Crate ready for installation	7-Oct-03	30-Apr-03	Yes
1.2.1.10.3	First set of Calorimeter phototubes tested	20-Oct-03	20-Oct-03	Yes
1.2.2.2.7.10	Upstairs components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.11	All EM Timing components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.6	ASD/TB ready for installation	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.7	Downstairs components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.9	TDC boards ready for installation	7-Jan-04	16-Oct-03	Yes
1.2.1.10.2	1st Calorimeter WLS fiber holder finished	1-Apr-04	17-Feb-04	Yes
1.2.1.10.4	1st CPR module finished and tested	4-Jun-04	15-Mar-04	Yes
1.2.1.10.6	1st CCR module finished and tested	19-Jul-04	2-Mar-04	Yes
1.2.1.10.5	2nd set of Calorimeter phototubes tested	6-Aug-04	26-Mar-04	Yes
1.2.1.10.7	50% Calorimeter CPR Detectors Tested	14-Jan-05	30 June 04	Yes
1.2.1.10.8	50% Calorimeter CCR Detectors tested	14-Feb-05	25 Aug 04	Yes
1.2.1.10.9	Final Calorimeter CPR Detector Tested	15-Apr-05	25 Aug 04	Yes
1.2.1.10.10	Final Calorimeter CCR Detector Tested	15-Apr-05	15-Apr-05	
1.2.1.10.11	Final set of Calorimeter phototubes tested	6-May-05	6-June-04	Yes
1.2.1.10.12	End of Central Pre-shower Project	6-May-05	6-May-05	
1.2.3.5	End of Calorimeter Project: Level 2	6-May-05	6-May-05	
1.2.3.6	End of Calorimeter Project: Level 1	23-Jan-06	6-May-05	

IV. PROCUREMENT – P. Lukens

No significant procurements were placed during September 2004.

V. PROJECT HIGHLIGHTS

1.2 – Calorimeter

1.2.1 Central Preshower and Crack Detector – Steve Kuhlmann

The CPR upgrade project continued the installation phase in the month of September. The first half of the detector is installed and tested with cosmic rays. The rest of the detector will be installed by early November.

The table below shows the current production status of the CPR and CCR components:

Component	Produced	Total needed	Complete
Preshower tiles	2592	2592	100%
Preshower spliced fibers	2592	2592	100 %
Preshower fiber pigtails	192	192	100 %
Preshower modules	48	48	100 %
Crack tiles	480	480	100 %
Crack spliced fibers	480	480	100 %
Crack pigtails	48	48	100 %
Crack modules	48	48	100 %
Preshower & Crack clear fiber cables	144	192	75%
Transition cards	96	96	100 %
PMT boxes	48	48	100 %

1.2.2 Electromagnetic Timing – Dave Toback

All EM Timing work has been completed.

1.3 – Data Acquisition and Trigger

1.3.1 TDC (Time to Digital Converter) – Henry Frisch, Ting Miao

During the month of September, five preproduction TDC's were received and tested successfully at the University of Chicago. A TDC Review was held on Sept 28 to evaluate the viability of IIa design for the remainder of Run II. A report is expected in the 1st week of October. We demonstrated the 64 bit CBLT transfers at a measured rate of 36 MB per second. Tests with ASD's and the XFT output are underway at Fermilab.

1.3.2 Level 2 – Ted Liu

The table below shows the current production status of the Level 2 components:

Component	Produced	Total needed	Complete
Pulsar boards	30	30	100 %
S-Link LSC/LDC cards	20	20	100 %
S-Link PCI cards	6	6 (Ops) + 6 (Spares)	50 %
S-Link fibers	30	30	100 %
AUX cards	20	20	100 %
Hotlink mezzanine cards	20	20	100 %
Taxi mezzanine cards	30	30	100 %
Hotlink/Taxi fibers	120	120	100 %
Fiber splitters	60	60	100 %
L2 decision CPUs	4	6	67 %

We held an installation/operation readiness review for the overall Level 2 decision crate. The review committee's report was complimentary of the progress so far and validated our detailed installation and integration plan and schedule for final commissioning during the spring of 2005.

1.3.11 XFT (eXtremely Fast Tracker) II – Richard Hughes, Brian Winer

The Stereo Finder board schematics are finished and they are undergoing review. SLAM board layout is nearing completion. A review of the SLAM board was held on the 24 September in preparation for sending it out to be built (preproduction). No major problem areas were discovered and the review committee suggested minor improvements to the design. This will go out for preproduction in October.

1.3.4 Event Builder – Bruce Knuteson

Core pieces of our connection design (including a Client and Server, and an "Agent" that coordinates message passing among the different actors in the design) are now in place. Rate studies have been performed and we have determined that splitting the VME backplanes of the DAQ VRB crates will help increase the data throughput that can be achieved. Progress has been made on code that will allow the Trigger Manager to communicate via Ethernet rather than ScramNet, used in the current system.

1.3.6 SVT (Silicon Vertex Tracker) – Mel Shochet

AM++:
Each of the three prototype boards was assembled: the AM++ VME board, the Lamb board, and the AMchip test board. Some problems were found in fabrication, which were worked around. These will be fixed when the next boards are produced. Test stands were set up for both the standard cell chip and the LAMB. Testing commenced.

AMS/RW:
Firmware design began so that data can be fed from a Pulsar into the AM++ boards. The functionality was first partitioned among the three FPGAs. Then the needed software development tools were obtained. The "glue" and much of dataio2 firmware was written. Simulation of this code continues.

Hit Buffer:
The distribution of functionality among the FPGAs was revisited, and it was found that the control FPGA and one of the IO FPGAs will suffice. A note with the revised Hit Buffer specifications is in preparation, and initial firmware and software simulation has begun.

Track Fitter:
The new firmware was largely completed, with both types of FPGAs fully compiled for the first time. This enabled us to determine how much memory is available for the spy buffers and FIFO in the control chip, as well as a confirmation that three fitters can fit inside one FPGA.

Pulsar Mezzanine Cards:
The requirements of all three Pulsar varieties were reviewed. We found that the simplest solution is to build two types of mezzanine cards, each a single-width board. Timing simulations started using the selected chips and the Pulsar line lengths and terminations.

VI. FINANCIAL STATUS (as of 30 September 2004)

The baseline cost of the Project is $10,375K, and consists of the costs for the scope of the Run IIb Project ($8,702K) plus the closeout costs of the silicon detector upgrade ($1,673K), which will no longer be constructed.

CDF RunIIb Obligations Report - This report provides a summary, at Level 2, of outstanding requisitions and purchase orders where money has been committed but for which the Project has not been invoiced. This does not include requisitions in the system which have not had a Fermilab Purchase Order number assigned as of the date of the report. A brief description of the columns included in this report is given below:

- Current Month Total Cost – The cost charged to the project for the reporting month.
- Current Month Obligation – This is the total of the obligations made against the project for the reporting month.
- Year to Date Total Cost – This is the total cost charged to the project in this fiscal year.
- Year to Date Obligations with Indirect – This is the total of the obligations made against the project for this fiscal year.
- Current Purchase Orders Open Commitment – This is the total of the open commitments against the project. It includes open commitments from the current and all prior years.
- Prior Year Total Cost - This is the total cost charged to the project in all prior fiscal years.

The total project cost is simply the sum of the Year-to-Date costs and the Prior Year costs. The total committed and spent is the Total Project Cost plus the Open Commitment value.

CDF Project Obligations Report
Through 30 September 2004

CDF RIIb EQU - September FYO4 IN $K								
Task Number	Expenditure Category		Current Month Total Cost	Current Month Obligation	YTD Total Cost	YTD Obligations w/Indirect	Current PO Open Comm	Prior Yr Total Cost
Silicon		M&S	19.6	(2.8)	318.1	(322.8)	103.5	221.0
		SWF	(0.4)	(0.4)	225.0	225.0	0.0	346.1
		OH	0.6	0.0	90.7	90.7	0.0	140.2
		Total 1.1	19.8	(3.2)	633.8	(7.1)	103.5	707.2
Calorimeter		M&S	16.1	19.9	211.8	255.3	43.5	0.0
		SWF	4.1	4.1	118.4	118.4	0.0	20.6
		OH	1.0	0.0	45.2	45.2	0.0	6.3
		Total 1.2	21.2	24.0	375.4	418.9	43.5	26.9
Trigger		M&S	309.2	50.2	705.3	628.5	57.6	2.9
		SWF	77.5	77.5	220.7	220.7	0.0	0.0
		OH	53.7	0.0	128.7	128.7	0.0	0.5
		Total 1.3	440.5	127.7	1,054.7	977.9	57.6	3.4
Administration		M&S	0.0	0.0	15.8	15.8	0.0	13.3
		SWF	18.4	18.4	141.5	141.5	0.0	126.7
		OH	5.0	0.0	44.3	44.3	0.0	40.1
		Total 1.4	23.3	18.4	201.6	201.6	0.0	180.1
Total Project		M&S	345.0	67.3	1,251.0	576.8	204.5	237.2
		SWF	99.7	99.7	705.6	705.6	0.0	493.5
		OH	60.3	60.3	308.9	308.9	0.0	187.0
Grand Total			504.9	227.2	2,265.5	1,591.3	204.5	917.6

TOTAL PROJECT COST (INCEPTION TO DATE):	3,183.1

CDF Project Cost Performance Report (CPR) – This report is generated from COBRA and provides a summary of the WBS 1.2-1.4 costs of the Project down to Level 3 of the Work Breakdown Structure. The closeout for the silicon detector subproject does not have its performance tracked here. Input data originates with the status (% Complete) of the Project schedules as reported by the Level 2 managers and actual costs extracted from the Fermilab accounting system. Where possible, costs are accrued for items that have been delivered, but not yet invoiced. This is only possible for a small fraction of our cost. Financial summaries are shown for this reporting period (columns 2-6) as well as the project to date (columns 7-11). Column 12 contains our baseline BAC, and will only be changed after the formal implementation of the Change Control process. Column 13 is the projected BAC, based on the current month's schedule. A number of specialized financial terms and abbreviations used in the CPR are defined here for convenience:

ACWP – Actual Cost of Work Performed. This is the actual cost of tasks that have been completed.

BAC – Budget at Completion. The BAC is the estimated total cost of the project when completed. It is equivalent to the BCWS at completion. The baseline value of the BCWS is contained in column 12 of the Cost Performance Report.

BCWP – Budgeted Cost of Work Performed. This is the scheduled cost profile of tasks that have been completed.

BCWS – Budgeted Cost of Work Scheduled. This is the sum of the budgets for all planned work to be accomplished within a given time period.

CV – Cost Variance. $CV = BCWP - ACWP$

EAC – Estimate At Completion. This is the ACWP to date, plus the BCWS (current scheduled estimate) of remaining tasks. $EAC = (BAC\ (current) - BCWP) + ACWP$

ETC – Estimate to Completion. $ETC = EAC - ACWP + Contingency$

Percent Complete - $\%Com = \frac{BCWP}{BAC}$

SV – Schedule Variance. $SV = BCWP - BCWS$

CDF Project
Cost Performance Report
at WBS Level 3

Cost Performance Report - Work Breakdown Structure														
Contractor: Location:					Contract Type/No:			Project Name/No: CDF RIIb Mstr Equ		Report Period: ####### 9/30/2004				
Quantity 1	Negotiated Cost 8,701,999		Est. Cost Authorized Unpriced Work 0		Tgt. Profit/ Fee % 0 0.00	Tgt. Price 8,701,999		Est Price 0	Share Ratio	Contract Ceiling 0	Estimated Contract Ceiling 0			
Funding Type-CA WBS[2] WBS[3] Item	Current Period					Cumulative to Date					At Completion			
	Budgeted Cost		Actual Cost	Variance		Budgeted Cost		Actual Cost	Variance					
	Work Scheduled	Work Performed	Work Performed	Schedule	Cost	Work Scheduled	Work Performed	Work Performed	Schedule	Cost	Budgeted	Latest Revised Estimate	Variance	
EQU Equipment														
1.2 Calorimeter Upgrades														
1.2.1 Central Preshower & Crack Detectors	15,156	6,647	21,214	-8,509	-14,567	371,496	371,024	378,606	-472	-7,583	377,440	377,440	0	
1.2.2 Electromagnetic timing	0	0	0	0	0	35,630	35,630	23,403	0	12,227	35,630	35,630	0	
WBS[2]Totals:	15,156	6,647	21,214	-8,509	-14,567	407,126	406,654	402,009	-472	4,645	413,070	413,070	0	
1.3 Run 2b DAQ and Trigger Project														
1.3.11 Revised XFTII Project	63,630	58,220	37,399	-5,410	20,821	158,459	145,347	85,144	-13,112	60,203	1,621,527	1,620,143	-1,384	
1.3.1 Run 2b TDC Project	51,648	7,055	32,039	-44,593	-24,984	325,297	278,296	361,420	-47,002	-83,124	1,081,850	1,084,503	2,653	
1.3.2 Run 2b Level 2 Project	3,448	0	166,203	-3,448	-166,203	271,358	354,021	305,042	82,663	48,980	363,735	364,086	352	
1.3.4 Event-Builder Upgrade	20,666	4,882	12,181	-15,784	-7,299	257,731	224,783	113,774	-32,948	111,009	518,804	518,441	-363	
1.3.5 Computer for Level3 PC Farm / DAQ	0	0	192,680	0	-192,680	0	85,540	192,680	85,540	-107,139	479,403	479,403	0	
1.3.6 SVT upgrade	186	8,845	0	8,659	8,845	186	8,845	0	8,659	8,845	297,441	363,600	66,159	
WBS[2]Totals:	139,578	79,001	440,500	-60,577	-361,499	1,013,033	1,096,832	1,058,059	83,800	38,773	4,362,760	4,430,176	67,416	
1.4 Administration														
1.4.3 Construction Phase	23,713	23,633	23,347	-80	286	498,658	498,658	381,723	0	116,934	958,867	958,867	0	
WBS[2]Totals:	23,713	23,633	23,347	-80	286	498,658	498,658	381,723	0	116,934	958,867	958,867	0	
Funding Type-CA Totals:	178,447	109,281	485,061	-69,166	-375,781	1,918,816	2,002,144	1,841,791	83,327	160,352	5,734,697	5,802,113	67,416	
Sub Total	178,447	109,281	485,061	-69,166	-375,780	1,918,816	2,002,144	1,841,791	83,327	160,352	5,734,697	5,802,113	67,416	
Management Resrv.											2,967,303	2,899,887	-67,416	
Total	178,447	109,281	485,061	-69,166	-375,780	1,918,816	2,002,144	1,841,791	83,327	160,352	8,702,000	8,702,000	0	

The table below contains current values for selected financial tracking quantities that do not appear in the standard Obligations or Cost Performance Reports. For the Silicon Detector portion of the project, we assume a BAC of $1673K and obtain the ACWP from the Obligations report. Remaining portions of the project have their costs listed in the Cost Performance Report.

	31 August 2004	30 September 2004
Estimate at Completion	$6,871K	$7,247 K
Estimate to Completion	$7,160 K	$6,939 K
Percent Complete	48 %	50 %

VII. VARIANCE ANALYSIS – P. Lukens

Subproject	Schedule Variance	Cost Variance
Central Preshower and Crack	Not Significant	Not significant
Electromagnetic Timing	None	Not Significant
Run 2b TDC	Not Significant	Labor charges are higher than planned. This will be reviewed after the September production review.
Run 2b Level 2	Ahead of schedule	Not Significant
Run 2b XFTII	Not Significant	Not Significant
Event Builder	Not Significant.	Costs are low. Some engineering has been done with physicist (no cost) labor
Computers for Level 3 and DAQ	Ahead of schedule	Error in status. A large purchase was completed, but not correctly statused in the schedule.
SVT Upgrade	None	None
Administration	None	Costs for support and travel have been below estimates.

VIII. BASELINE CHANGES

No Change Control Requests were submitted or approved during September 2004.

IX. FUNDING PROFILES

The funding profile is shown below:

	Funding Plan in Current Year $K				
	FY02	FY03	FY04	FY05	Total
DOE MIE	$ 3,460	$ 3,509	$ 1,673	$ 1,732	$ 10,375
DOE R&D	$ 1,670	$ 480			$ 2,150
Foreign Contributions	$ 39	$ 342	$ 252	$ 10	$ 643
U.S. Universities	$ 24	$ 225	$ 103	$ 26	$ 378
Total	$ 5,193	$ 4,556	$ 2,028	$ 1,768	$ 13,545